UTILITY PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.:	10/646,509	Confirm. No.:	9658
Applicant:	Brice A. Johnson	Art Unit:	1733
Filed:	August 22, 2003	Examiner:	Aftergut, Jeff H.
Docket No.:	024.0225 (02-0502)	Customer No.:	55,397

Title: MULTIPLE HEAD AUTOMATED COMPOSITE LAMINATING MACHINE FOR THE FABRICATION OF LARGE BARREL SECTION COMPONENTS

RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In response to the Office Action dated November 3, 2006, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims that begins on page 2 of this paper.

Remarks begin on page 17 of this paper.

IN THE CLAIMS

1.-37. (Cancelled)

Please add new claims 38-87 as follows:

38. (New) A device for fabricating a section of an aircraft fuselage via automated composite lamination on a mandrel surface, comprising:

a mandrel comprising a rotational axis and the mandrel surface, wherein the mandrel surface substantially conforms to the section of the aircraft fuselage;

a mechanical supporting structure moveable relative to the mandrel, wherein the mandrel is rotatable relative to said mechanical supporting structure; and

a plurality of material delivery heads supported by said mechanical supporting structure, wherein said mechanical supporting structure provides for movement of said plurality of material delivery heads relative to the mandrel surface during fabrication of the section of the aircraft fuselage, and wherein each of said plurality of material delivery heads is:

designed to apply composite material along the mandrel surface during fabrication of the section of the aircraft fuselage; and

individually positionally adjustable relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

39. (New) The device of claim 38, wherein each of said plurality of material delivery heads is:

rotatable about an axis normal to the rotational axis during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

40. (New) The device of claim 38, wherein at least one of the material delivery heads is designed to apply composite material at a first angle relative to the mandrel, while at least one of the other material delivery heads is simultaneously applying composite material at a second angle relative to the mandrel.

41. (New) The device of claim 38, wherein said mechanical supporting structure comprises a ring surrounding said mandrel surface and said device further comprises:

a ring cradle, wherein:

said ring cradle supports said ring, and

said ring cradle moves along the direction of the rotational axis of the mandrel.

42. (New) The device of claim 38, further comprising:

an arm mechanism connecting said at least one material delivery head to said mechanical supporting structure and providing motion of said at least one material delivery head relative to the mandrel surface.

43. (New) The device of claim 38, further comprising:

a tail stock that holds the mandrel and provides for rotation of the mandrel about the rotational axis of the mandrel.

44. (New) The device of claim 38, wherein at least one of said plurality of material delivery heads is based on a flat tape laying delivery head.

45. (New) The device of claim 38, wherein at least one of said plurality of material delivery heads is based on a contour tape laying delivery head.

46. (New) The device of claim 38, wherein said mechanical supporting structure comprises a ring surrounding said mandrel surface, said ring connected to at least one vertical support post.

47. (New) The device of claim 38, further comprising a horizontal turntable that supports the mandrel so that the rotational axis of the mandrel is vertical.

48. (New) The device of claim 38, further comprising at least one creel system mounted on said mechanical supporting structure, wherein said creel system provides material to at least one of said plurality of material delivery heads.

49. (New) The device of claim 38, wherein at least one of said plurality of material delivery heads is a fiber placement head.

50. (New) The device of claim 38, wherein each of the material delivery heads is designed to apply the composite material in a ply orientation that is independent of ply orientations of the other material delivery heads.

51. (New) A device for fabricating a section of an aircraft fuselage via automated composite lamination on a mandrel surface, comprising:

a mandrel comprising a rotational axis and the mandrel surface, wherein the mandrel surface substantially conforms to the section of the aircraft fuselage;

a mechanical supporting structure moveable relative to the mandrel, wherein the mandrel is rotatable relative to said mechanical supporting structure; and

a plurality of material delivery heads supported by said mechanical supporting structure, wherein:

said mechanical supporting structure provides for axial translation of said plurality of material delivery heads simultaneously relative to the mandrel surface during fabrication of the section of the aircraft fuselage, and wherein each of said plurality of material delivery heads is:

designed to apply composite material along the mandrel surface during fabrication of the section of the aircraft fuselage; and

individually positionally adjustable relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

52. (New) The device of claim 51, wherein each of said plurality of material delivery heads is:

rotatable about an axis normal to the rotational axis during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

53. (New) The device of claim 51, wherein at least one of the material delivery heads is designed to apply composite material at a first angle relative to the mandrel, while at least one of the other material delivery heads is simultaneously applying composite material at a second angle relative to the mandrel.

54. (New) The device of claim 51, wherein said mechanical supporting structure comprises a ring surrounding said mandrel surface, and said device further comprises a ring cradle, wherein:

said ring cradle supports said ring in a vertical orientation, and

said ring cradle moves along the direction of the axis of the mandrel to provide said axial translation of said plurality of material delivery heads simultaneously relative to the mandrel surface.

55. (New) The device of claim 51, further comprising:

an arm mechanism connecting said at least one material delivery head to said mechanical supporting structure, wherein:

said arm mechanism provides motion of said at least one material delivery head relative to the mandrel surface; and

said arm mechanism provides an axial position adjustment of said at least one material delivery head relative to the mandrel surface.

56. (New) The device of claim 51, further comprising:

a tail stock that holds the mandrel so that the axis of the mandrel is horizontal and provides for horizontal rotation of the mandrel about the axis.

57. (New) The device of claim 51, wherein at least one of said plurality of material delivery heads is chosen from the group consisting of: flat tape laying delivery head, contour tape laying delivery head, fiber placement delivery head.

58. (New) The device of claim 51, further comprising a horizontal turntable and wherein:

said mechanical supporting structure comprises a ring surrounding said mandrel surface,

said ring is connected to a vertical support post that provides vertical movement of said ring, and

said horizontal turntable supports the mandrel so that the axis of the mandrel is vertical.

59. (New) The device of claim 51, further comprising at least one creel system mounted on said mechanical supporting structure, wherein said creel system provides material to at least one of said plurality of material delivery heads and said at least one of said plurality of material delivery heads is a fiber placement head.

60. (New) The device of claim 51, wherein said plurality of material delivery heads are simultaneously controllable independent of each other.

61. (New) The device of claim 51, wherein each of the material delivery heads is designed to apply the composite material in a ply orientation that is independent of ply orientations of the other material delivery heads.

62. (New) A device for fabricating a section of an aircraft fuselage via automated composite lamination on a mandrel surface, comprising:

a mandrel comprising a rotational axis and the mandrel surface, wherein the mandrel surface substantially conforms to the section of the aircraft fuselage;

a mechanical supporting structure moveable relative to the mandrel, wherein the mandrel is rotatable relative to said mechanical supporting structure; and

a plurality of material delivery heads supported by said mechanical supporting structure and disposed surrounding the mandrel, wherein:

said mechanical supporting structure provides for: axial translation of said plurality of material delivery heads simultaneously relative to the mandrel surface during

fabrication of the section of the aircraft fuselage, and wherein each of said plurality of material delivery heads is:

designed to apply composite material along the mandrel surface during fabrication of the section of the aircraft fuselage; and

individually positionally adjustable relative to the mandrel surface, the mechanical supporting structure and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

63. (New) The device of claim 62, wherein each of said plurality of material delivery heads is:

rotatable about an axis normal to the rotational axis during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

64. (New) The device of claim 62, wherein at least one of the material delivery heads is designed to apply composite material at a first angle relative to the mandrel, while at least one of the other material delivery heads is simultaneously applying composite material at a second angle relative to the mandrel.

65. (New) The device of claim 62, further comprising:

an arm mechanism connecting said at least one material delivery head to said mechanical supporting structure, wherein:

said arm mechanism provides motion of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface in a direction normal to the mandrel surface;

said arm mechanism provides rotation of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface about an axis normal to the mandrel surface;

said arm mechanism provides a circumferential position adjustment of said at least one material delivery head independent of the other material delivery heads and in a hoop direction relative to the mandrel surface; and

said arm mechanism provides an axial position adjustment of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface.

66. (New) The device of claim 62, wherein said mechanical supporting structure comprises a ring surrounding said mandrel surface, and said device further comprises:

a tail stock that holds the mandrel so that the rotational axis of the mandrel is horizontal and provides for horizontal rotation of the mandrel; and

a ring cradle, wherein:

said ring cradle supports said ring in a vertical orientation,

said ring cradle moves along the direction of the rotational axis of the mandrel to provide said axial translation of said plurality of material delivery heads simultaneously relative to the mandrel surface,

at least one of said plurality of material delivery heads is a tape laying delivery head; and

said plurality of material delivery heads is capable of laying down at least 700 lbs/hr of composite material.

67. (New) The device of claim 62, further comprising a horizontal turntable and at least one creel system, wherein:

said horizontal turntable supports the mandrel so that the rotational axis of the mandrel is vertical and rotates the mandrel about the rotational axis of the mandrel,

said mechanical supporting structure comprises a ring oriented horizontally and surrounding said mandrel surface,

said ring is connected to at least one vertical support post that provides vertical movement of said ring,

said at least one creel system is mounted on said ring,

said creel system provides material to at least one of said plurality of material delivery heads,

said at least one of said plurality of material delivery heads is a fiber placement head, and

said plurality of material delivery heads is capable of laying down at least 300 lbs/hr of composite material.

68. (New) The device of claim 62, wherein each of said plurality of material delivery heads is individually controllable independently of said other material delivery heads and in coordination with rotation of the mandrel surface of the mandrel.

69. (New) An aircraft part manufacturing device for fabricating a section of an aircraft fuselage via automated composite lamination on a mandrel surface, comprising:

a mandrel comprising a rotational axis and the mandrel surface, wherein the mandrel surface substantially conforms to the section of the aircraft fuselage;

a mechanical supporting structure moveable relative to the mandrel, wherein the mandrel is rotatable relative to said mechanical supporting structure;

a plurality of material delivery heads supported by said mechanical supporting structure and disposed surrounding the mandrel, wherein said mechanical supporting structure provides for axial translation of said plurality of material delivery heads relative to the mandrel surface during fabrication of the section of the aircraft fuselage, and wherein each of said plurality of material delivery heads is:

designed to apply composite material along the mandrel surface during fabrication of the section of the aircraft fuselage;

individually positionally adjustable relative to the mandrel surface, the mechanical supporting structure and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage; and

an arm mechanism connecting said at least one material delivery head to said mechanical supporting structure, wherein:

said arm mechanism provides motion of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface in a direction normal to the mandrel surface;

said arm mechanism provides rotation of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface about an axis normal to the mandrel surface;

said arm mechanism provides a circumferential position adjustment of said at least one material delivery head independent of the other material delivery heads and in a hoop direction relative to the mandrel surface; and

said arm mechanism provides an axial position adjustment of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface.

70. (New) The device of claim 69, wherein each of said plurality of material delivery heads is:

rotatable about an axis normal to the rotational axis during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

71. (New) The device of claim 69, wherein at least one of the material delivery heads is designed to apply composite material at a first angle relative to the mandrel, while at least one of the other material delivery heads is simultaneously applying composite material at a second angle relative to the mandrel.

72. (New) The device of claim 69, wherein each of said plurality of material delivery heads is individually controllable independently of said other material delivery heads and in coordination with rotation of the mandrel surface of the mandrel.

73. (New) An aircraft part manufacturing device for fabricating a section of an aircraft fuselage via automated composite lamination on a mandrel surface, comprising:

a mandrel comprising a rotational axis and the mandrel surface, wherein the mandrel surface substantially conforms to the section of the aircraft fuselage;

means for supporting a plurality of material delivery heads, wherein the mandrel is moveable relative to said plurality of material delivery heads during fabrication of the section of the aircraft fuselage, and wherein each of said plurality of material delivery heads is

designed to apply composite material along the mandrel surface during fabrication of the section of the aircraft fuselage;

means for providing for movement of said plurality of material delivery heads relative to the mandrel surface during fabrication of the section of the aircraft fuselage; and

means for providing an individual position adjustment relative to the mandrel surface for said plurality of material delivery heads during fabrication of the section of the aircraft fuselage, wherein each of said plurality of material delivery heads is: individually positionally adjustable relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

74. (New) The device of claim 73, wherein at least one of the material delivery heads is designed to apply composite material at a first angle relative to the mandrel, while at least one of the other material delivery heads is simultaneously applying composite material at a second angle relative to the mandrel.

75. (New) The device of claim 73, wherein said means for supporting said plurality of material delivery heads includes means for translating said plurality of material delivery heads in an axial direction relative to said mandrel.

76. (New) The device of claim 73, wherein said means for providing an individual position adjustment comprises:

means for providing an axial position adjustment of said material delivery heads relative to the mandrel surface and independent of the other material delivery heads.

77. (New) The device of claim 73, wherein said means for providing an individual position adjustment comprises:

means for providing a circumferential position adjustment of said material delivery heads in a hoop direction relative to the mandrel surface and independent of the other material delivery heads.

78. (New) The device of claim 73, wherein each of said plurality of material delivery heads is: rotatable about an axis normal to the rotational axis during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage, and wherein said means for providing an individual position adjustment comprises:

means for providing a motion of said material delivery heads relative to the mandrel surface in a direction normal to the mandrel surface and independent of the other material delivery heads; and

means for providing a rotation of said material delivery heads relative to the mandrel surface about an axis normal to the mandrel surface and independent of the other material delivery heads.

79. (New) The device of claim 73, wherein said means for providing an individual position adjustment comprises:

means for individually controlling each of said plurality of material delivery heads independently of the other material delivery heads and in coordination with rotation of the mandrel surface of the mandrel.

80. (New) The device of claim 73, wherein each of said plurality of material delivery heads is individually controllable independently of said other material delivery heads and in coordination with rotation of the mandrel surface of the mandrel.

81. (New) A method for fabricating a section of an aircraft fuselage using a plurality of material delivery heads to apply composite materials on a mandrel surface of a mandrel having an axis, wherein the mandrel is rotatable relative to said plurality of material delivery heads, and wherein the mandrel surface substantially conforms to the section of the aircraft fuselage, the method comprising steps of:

applying, via the material delivery heads, composite material along the mandrel surface during fabrication of the section of the aircraft fuselage;

moving at least some of said material delivery heads relative to the mandrel surface during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage; and

individually adjusting positions of at least some of said material delivery heads relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

82. (New) The method of claim 81, further comprising the step of:

rotating at least some of said material delivery heads about an axis normal to the rotational axis during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage.

83. (New) The method of claim 81, wherein at least one of the material delivery heads is designed to apply composite material at a first angle relative to the mandrel, while at least one of the other material delivery heads is simultaneously applying composite material at a second angle relative to the mandrel.

84. (New) The method of claim 81, wherein said step of moving comprises:

translating said plurality of material delivery heads simultaneously in an axial direction relative to said mandrel.

85. The method of claim 81, wherein said step of individually adjusting comprises:

providing a circumferential position adjustment of said material delivery head independent of the other material delivery heads and in a hoop direction relative to the mandrel surface; and

providing an axial position adjustment of said material delivery head independent of the other material delivery heads and relative to the mandrel surface.

86. (New) The method of claim 81, wherein said step of individually adjusting comprises:

providing a motion of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface in a direction normal to the mandrel surface;

providing a rotation of said at least one material delivery head independent of the other material delivery heads and relative to the mandrel surface about an axis normal to the mandrel surface.

87. (New) The method of claim 81, wherein said step of individually adjusting comprises:

individually controlling each of said plurality of material delivery heads independently of the other material delivery heads and in coordination with rotation of the mandrel surface of the mandrel.

88. (New) The method of claim 81, further comprising steps of:

rotating the mandrel about a horizontal axis of rotation; and

delivering the composite material from said plurality of material delivery heads, wherein:

at least one of said plurality of material delivery heads is a tape laying machine; and

said plurality of material delivery heads lays down at least 700 lbs/hr of composite material at peak rate.

89. (New) The method of claim 81, further comprising steps of:

rotating the mandrel about a horizontal axis of rotation; and

delivering the composite material from said plurality of material delivery heads, wherein:

at least one of said plurality of material delivery heads is a fiber placement head, and

said plurality of material delivery heads lays down at least 300 lbs/hr of composite material at peak rate.

90. (New) The method of claim 81, wherein each of said plurality of material delivery heads is individually controllable independently of said other material delivery heads and in coordination with rotation of the mandrel surface of the mandrel.

91. (New) A device for fabricating a section of a vehicle via automated composite lamination on a mandrel surface, comprising:

a mandrel comprising a rotational axis and the mandrel surface, wherein the mandrel surface substantially conforms to the section of the vehicle;

a mechanical supporting structure moveable relative to the mandrel, wherein the mandrel is rotatable relative to said mechanical supporting structure; and

a plurality of material delivery heads supported by said mechanical supporting structure, wherein said mechanical supporting structure provides for movement of said plurality of material delivery heads relative to the mandrel surface during fabrication of the section of the vehicle, and wherein each of said plurality of material delivery heads is:

designed to apply composite material along the mandrel surface during fabrication of the section of the vehicle; and

individually positionally adjustable relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the vehicle.

92. (New) A method for fabricating a section of a vehicle using a plurality of material delivery heads to apply composite materials on a mandrel surface of a mandrel having an axis, wherein the mandrel is rotatable relative to said plurality of material delivery heads, and wherein the mandrel surface substantially conforms to the section of the vehicle, the method comprising steps of:

applying, via the material delivery heads, composite material along the mandrel surface during fabrication of the section of the vehicle;

moving at least some of said material delivery heads relative to the mandrel surface during application of the composite material by the material delivery heads during fabrication of the section of the vehicle; and

individually adjusting positions of at least some of said material delivery heads relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the vehicle.

REMARKS

Applicants appreciate the thorough examination of the application that is reflected in the Office Action dated November 3, 2006. To expedite the prosecution of this application, this Response cancels all of the pending claims 1-37 without prejudice or disclaimer, and adds new claims 38-92.

After entry of the foregoing amendments, claims 38-92 (55 total claims; 8 independent claims) are pending in the application. Reconsideration of the application is respectfully requested in view of the above amendments and the following remarks.

Claim Rejections Under 35 U.S.C. 112, 2nd paragraph

The Office Action rejects claims 1-23 under 35 U.S.C. 112, 2nd paragraph as allegedly being indefinite.

Applicants submit that this rejection is moot in light of the cancellation of claims 1-23.

Accordingly, for at least this reason, Applicants submit that the rejection of claims 1-23 under 35 U.S.C. 112, 2nd paragraph should be withdrawn.

Art-based Rejections

Claims 1-37

The Office Action rejects claims 1-30 under 35 U.S.C. 103(a) as being unpatentable over PCT WO 03/035380 in view of Koury and either one of Bendarzewski et al. or Zsolnay et al. further taken with the admitted prior art and E.P. 198,744 optionally further taken with Ermert, and rejects claims 1-37 under 35 U.S.C. 103(a) as being unpatentable over PCT WO 03/035380 in view of Koury and either one of Bendarzewski et al. or Zsolnay et al. further taken with the admitted prior art and E.P. 198,744 optionally further taken with Ermert and further taken with Ninet et al.

Applicants respectfully submit that these rejections are moot since claims 1-37 have been cancelled without prejudice. Accordingly, for at least this reason, Applicants submit that the rejection of claims 1-37 under 35 U.S.C. 112, 2nd paragraph should be withdrawn.

Interview Summary

Applicants thank the Examiner for his time during the telephone interview of January 25, 2007. As discussed during the telephone interview, Applicants submit that new independent claims 38, 51, 62, 69, 73, 81, 91 and 92 distinguish over the cited references. Applicants summarize some of the points made during that telephone interview below with reference to new independent method claim 81.

New independent claim 81 relates to a method for fabricating a section of an aircraft fuselage using a plurality of material delivery heads to apply composite materials on a mandrel surface of a mandrel having an axis. The mandrel is rotatable relative to said plurality of material delivery heads. The mandrel surface substantially conforms to the section of the aircraft fuselage. Claim 81 recites the steps of:

> applying, via the material delivery heads, composite material along the mandrel surface during fabrication of the section of the aircraft fuselage;
>
> moving at least some of said material delivery heads relative to the mandrel surface during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage; and
>
> individually adjusting positions of at least some of said material delivery heads relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage. (Emphasis added.)

To further highlight distinctions over the cited references, Applicants amend the preambles of each of the independent claims to recite "fabricating a section of an aircraft fuselage using a plurality of material delivery heads to apply composite materials on a mandrel surface," and that "the mandrel surface substantially conforms to the section of the aircraft fuselage." As discussed during the telephone interview, Applicants submit that the cited references, taken individually or in combination, fail to teach or suggest recitations, such as, "individually adjusting positions of at least some of said material delivery heads relative to the mandrel surface and the other material delivery heads during application of the composite material by the material delivery heads during fabrication of the section of the aircraft fuselage," as recited by new independent claim 81.

Accordingly, for at least the foregoing reasons, Applicants submit that new claim 81, and its dependent claims 82-90, are patentable over the cited references.

Independent Claims 38, 51, 62, 69, 73, 91 and 92

For reasons similar to those discussed above with respect to claim 81, Applicants submit that the other independent claims 38, 51, 62, 69, 73, 91 and 92, and their respective dependent claims 39-50, 52-61, 63-68, 70-72, 74-80 and 82-90 are also patentable over the cited references.

In conclusion, for the reasons given above, all claims now presently in the application are believed allowable and such allowance is respectfully requested. Should the Examiner have any questions or wish to further discuss this application, Applicants request that the Examiner contact the undersigned attorney at (480) 385-5060.

If for some reason Applicants have not requested a sufficient extension and/or have not paid a sufficient fee for this response and/or for the extension necessary to prevent abandonment on this application, please consider this as a request for an extension for the required time period and/or authorization to charge Deposit Account No. 50-2091 for any fee which may be due.

Respectfully submitted,

INGRASSIA FISHER & LORENZ

Dated: February 5, 2007

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